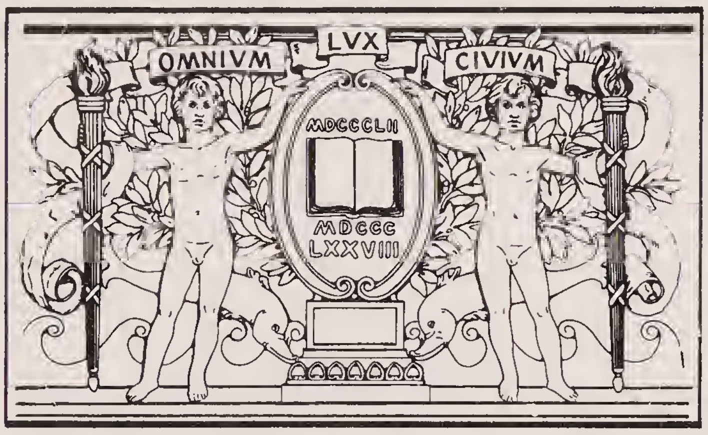
RECIPES FOR SCIENCE FUN

SUSAN STRAND NOAD

ILLUSTRATED BY
ARNOLD DOBRIN



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BY SUSAN STRAND NOAD
ILLUSTRATED BY ARNOLD DOBRIN

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This book is dedicated to
my parents, husband, and
children, who have always
been generous with their
support and encouragement.

RECIPES FOR SCIENCE FUN

SCIENCE IN THE KITCHEN

When you hear the words "scientist" and "scientific experiment," you probably think of a person in a white lab coat working in a room filled with glass bottles, test tubes, and test animals. But this does not have to be the case. You can be a scientist and conduct experiments right in your own kitchen.

Instead of a lab coat, you will probably be wearing a smock or an apron. Your expensive equipment will be the stove and refrigerator. The rest of your scientific tools will be the cooking utensils found in most kitchens. And, of course, your test animals will be none other than yourself, your family, and your friends.

You may have already made some of the recipes in this book and wondered why certain things happened. Why does bread dough rise? Why are some breads flat? Where do raisins come from? The answers to all these questions and more can be found in the pages of this book.

As you read through the book you will notice that the recipes included here are not the ordinary ones that people use when they are first learning to cook. The recipes included here were chosen not only because they are fun to make, but because the finished products are delicious and good for you.

Food that you prepare at home is often fresher than food you buy at a store because you choose the *ingredients*. You also come very close to eliminating the *preservatives* in your food when you prepare it at home. Preservatives help to keep our foods fresh for a longer period of time and in that way are beneficial. However, many people don't want preservatives added to their food. They feel that they are eating too many unhealthy chemicals, and are trying to eliminate as many as possible from their diet. So, by making their food at home, they have greater control over their intake of preservatives.

By using the recipes in this book you will not only be conducting scientific experiments, you'll be producing food that is good for you—and having fun.

GROWING SPROUTS

Have you ever wondered what happens to the seeds in your garden after you push them into the soil and cover them up? Usually, you don't see them again until green sprouts push through the dirt. There is a way to see exactly what is happening while growing fresh vegetables inside your house.

Any of the dried beans in the grocery store can be used for this experiment, but many of these make large, tough sprouts. Most people like to use alfalfa, soy, or mung beans where available, because they are small and easy to chew and digest.

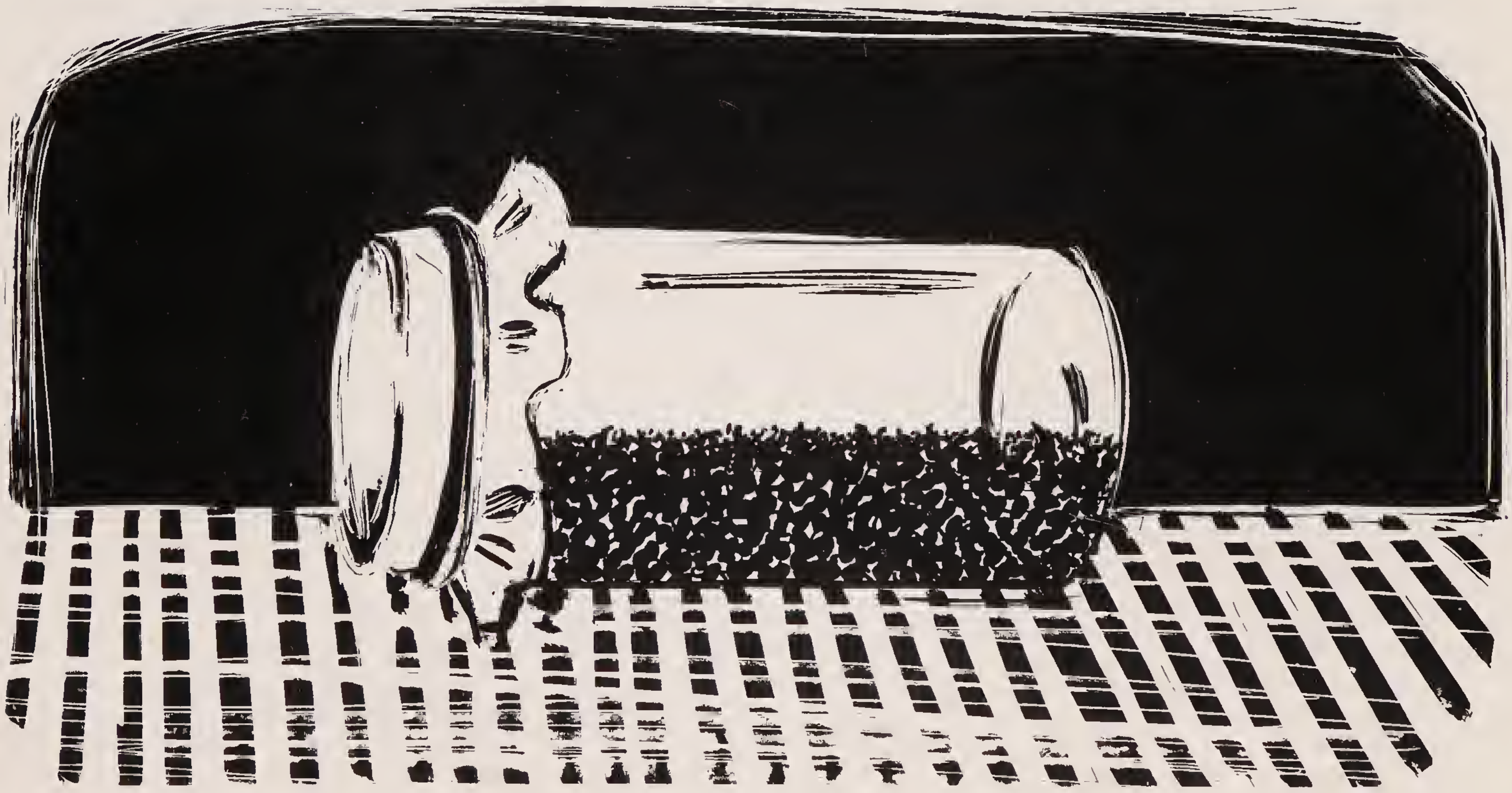
Materials

2 tablespoons of dried beans (15 ml)
1 large glass jar
Cheesecloth, about 6″ × 6″ (15 × 15 cm)
Rubber band

Method

1. Put the beans in the jar and cover with water. Soak overnight (about 8 hours).
2. Cover the jar with the cheesecloth and hold it in place with the rubber band. Drain off the water through the cheesecloth.
3. When all the water has been drained, add more water so the seeds can be rinsed off. Drain off this water, also.
4. Leave the cheesecloth cover on the jar and put the jar away in a dark place for 24 hours. During this time, rinse the seeds one more time. Place the jar on its side so the seeds are spread out and not all in a big, wet clump.
5. For the next 4 or 5 days, leave the jar in a sunny spot. The sprouts will begin to grow and turn green. Rinse them twice a day, and drain them well so that very little water is left in the jar.
6. When the sprouts are grown, they should be kept in the refrigerator and eaten in about one week.

Your bean sprouts can be eaten just as they are, or put into salads, omelets, or breads. They're even delicious in sandwiches. Try putting mayonnaise on one slice of bread, peanut butter on another, and sprouts between the two slices. Or try using banana slices, peanut butter, and sprouts on whole wheat bread. Both of these sandwiches look different, sound strange, but taste delicious and are good for you, too.



What Is Happening Scientifically

The beans that you are using have been dried out so they can be stored for a long time. However, they still each contain a baby plant called an *embryo* that needs only water, oxygen, and warmth to wake up from its *dormant*, or resting, state.

You must soak the beans overnight to give them the moisture they need for growing. If you have ever planted seeds in a garden, you also watered them to help them start to *germinate*. Germination is the process by which seeds grow and develop into seedlings. The water works its way through the seed coat to the embryo. This causes the seed to swell so much that the seed coat breaks. When this happens, the embryo begins to absorb oxygen, use more energy, and grow.

And just as you put them in the dark when you covered your seeds with soil, you must put these seeds in the dark also. Seeds start to germinate best in the dark.

When you take the seeds out of the dark place, look carefully and you will see that the outer covering of the seed has broken and a tiny sprout is pushing its way out. Now, just like any plant, your bean sprouts need sunlight. So the jar should be put in a sunny spot. All plants need water to continue growing, and this is why you must rinse your sprouts every day. But don't leave them in too much water, or your sprouts will not be able to breathe and will drown.

Your bean sprouts are ready to eat when they are from 1 to 2 inches (2.5 to 5 cm) long, depending on the size of seed you have used. Now you should keep them in the refrigerator to slow down the growing process and keep the sprouts from putting out complex root systems.

Bean sprouts are not only fun to grow, but like other fresh vegetables are a good source of vitamins. By having a sprout garden in your house, you will have a ready supply of vegetables high in protein and rich in B, C, and E vitamins.

MAKING MAYONNAISE

Most of us eat foods every day without thinking about the ingredients in them or how they are put together. Mayonnaise is certainly one of these foods. You use mayonnaise on your tomato sandwich, in your egg salad or tuna fish, or as part of your salad dressing. But have you ever wondered how it is made?

Centrifugal force is needed to combine the ingredients used in mayonnaise. This is the same force that causes you to lean outward when riding on a very fast merry-go-round. (Who would have thought that a ride on a merry-go-round and a tuna fish salad sandwich had anything in common?)

Materials

1 egg
2 tablespoons vinegar *or* lemon juice (30 ml)
½ teaspoon dry mustard (2.5 ml)
¼ teaspoon salt (1.2 ml)
1 cup salad oil (250 ml)
Electric blender

Method

---

1. Put the egg, vinegar or lemon juice, mustard, salt, and ½ cup (125 ml) salad oil into an electric blender.
2. Put on the cover.
3. Blend these ingredients for 15 seconds at medium speed.
4. During these 15 seconds, remove the small inner cap from the top of the blender and pour the rest of the oil quickly into the mixture.
5. Blend the entire mixture for 3 more seconds at a very high speed to make sure all the oil is blended into the mayonnaise.
6. Scrape the mayonnaise out of the blender using a spatula. Put it into a covered container and store in the refrigerator. Since there are no preservatives added, it is best to use your mayonnaise within two weeks.

What Is Happening Scientifically

If you have ever tried to mix salad oil and vinegar, you have probably noticed that they do not stay mixed for very long. This mixture of a liquid suspended in a liquid is called an *emulsion.*

The only way to keep the oil mixed together with the other materials is to break the oil up into very small particles. These particles must then be surrounded with another ingredient, in this case the egg yolk. The egg yolk is called an *emulsifier* and prevents the small particles of oil from joining together again.

One way to break the oil into very small particles is to spin it at very high speeds. The centrifugal force created by this spinning causes the oil to break apart into very small particles. You could not easily get the same effect by shaking the mixture or beating it with an electric mixer. A centrifugal force strong enough to break up the oil is created only if the mixture is spun in a circle at a very high speed.

COOKING UP COOKIES (USING DIFFERENT KINDS OF SWEETENERS)

Munchy, crunchy, gooey, chewy. After school with a glass of milk or after dinner as a dessert, a few home-baked cookies make your day a sweeter one.

When you are eating a cookie, can you tell which kind of sweetener has been used in it? With this recipe you will make three batches of cookies with three different sweeteners. After you have sampled the different batches, you will know which taste belongs with each type of sweetener.

Materials

1 cup flour (250 ml, 165 g)
1 teaspoon salt (5 ml)
½ teaspoon baking soda (2.5 ml)
3 cups oatmeal, uncooked (750 ml)
¾ cup (180 g) of soft margarine (¼ cup [60 g] in each bowl)
6 tablespoons (90 ml) water (2 tablespoons [30 ml] in each bowl)
1½ teaspoons (7.5 ml) vanilla (½ teaspoon [2.5 ml] in each bowl)
½ cup white sugar (125 ml, 105 g)
½ cup brown sugar (125 ml, 125 g)
¼ cup honey (60 ml)

Method

---

1. Preheat oven to 350° F (175° C) and grease three baking sheets.
2. Mix the flour, salt, baking soda, and oatmeal in a large bowl. Set this aside.
3. In a smaller bowl, mix ¼ cup (60 g) margarine, 2 tablespoons (30 ml) water, ½ teaspoon (2.5 ml) vanilla, and white sugar. In another small bowl, mix the same amounts of margarine, water, and vanilla with the brown sugar. In a third bowl, mix the rest of these ingredients with the honey.
4. Divide your flour and oatmeal mixture into three parts, with approximately 1⅓ cups (330 ml) in each part. Add one of these parts to each small bowl. Mix well.
5. Drop the dough onto the greased baking sheets by teaspoonfuls.
6. Bake for 12 to 15 minutes. Cool on wire racks.

What Is Happening Scientifically

White sugar is the sweetener we are most accustomed to eating. However, it doesn't have any *nutritional* value (vitamins or minerals) except the energy that it provides. Brown sugar has not been *refined* quite as much as white sugar and therefore provides a few minerals that are necessary in your diet. It is only slightly more nutritional than white sugar, however.

Unrefined or raw honey has the highest mineral value of these three sweeteners. It is best for you because nothing has been done to it except that it has been put into a jar. Check the label before you buy a jar of honey. Many manufactuers process it and remove most of the minerals which are a necessary part of your diet. Honey is also much sweeter than sugar and therefore a smaller amount is needed. Because it has a decidedly different taste than white sugar, it might take a little while to get used to the difference.

BAKING YEAST BREAD

When making bread, *kneading* the dough and watching it rise are fun. But many people will say that smelling the bread baking is even better than eating the first warm slice after it comes out of the oven. That wonderful smell will make your mouth water and bring a smile to your face.

The ingredient most responsible for all this happiness is a tiny plant called yeast. Yeast is used mainly to make the bread rise. But it also gives homemade bread its fragrance as it is baking.

Handle the yeast gently, as you would a tender plant, and you will be rewarded. Your nose, your mouth, and your tummy will be treated to a delightful experience.

Materials

3 cups lukewarm water (750 ml)
2 tablespoons yeast (2 packages or 30 ml)
⅔ cup honey *or* brown sugar (160 ml, 170 g)
1 cup instant powdered dry milk (250 ml)
1 tablespoon salt (15 ml)
½ cup oil (125 ml)
9 to 10 cups (2.2 to 2.5 l; 1.5 to 1.7 kg) flour (use half whole wheat)

Method

---

1. Dissolve yeast in lukewarm water. (If the water is too hot, it will kill the yeast.)
2. Add remaining ingredients except the flour and mix well. Put the mixture aside for 10 minutes. At the end of this time you will notice the mixture is bubbling. This means the yeast has already begun to work.
3. Stir in half the amount of flour. Mix until all the flour is moistened.
4. Stir in half the remaining flour.
5. Slowly add the rest of the flour until the dough comes away from the sides of the bowl. (The amount of flour needed varies with the temperature and the amount of moisture in the air. Sometimes you will need less than 10 cups (2.5 l) and sometimes you will need slightly more.)
6. Place dough on a floured cutting board *or* counter; knead until smooth and elastic. To knead, fold ball of dough in half. Push it lightly and quickly away from you several times,

stretching it slightly and gently with each push. Use the lower part of your palms. Fold the dough again and repeat the pushing.

7. Place dough in a greased bowl and cover with a towel. Place bowl in a quiet area, away from cold drafts.
8. Let rise until double in size—about 2 hours.
9. Turn dough out onto slightly floured board *or* counter and divide the dough into two equal parts.
10. To shape into loaves, stretch each piece of dough into a long, narrow rectangle. Fold each end into the middle. Bring the sides up over the folded part and pinch together to seal.
11. Place loaves into greased loaf pans, 8½″ × 4½″ × 2½″ (21.5 ×11 × 6 cm).
12. Let rise again until double—about ½ hour.
13. Preheat oven to 350° F (175° C) for 10 minutes.
14. Bake the bread for 50 to 60 minutes. Bread is done when it is golden brown and sounds hollow when you tap it.
15. Remove from oven and cool on a wire rack.

What Is Happening Scientifically

Yeast is a tiny plant that is a *fungus* similar to that which grows on food left too long in the refrigerator. Because the yeast is a living plant, you must be sure the water is only lukewarm, for if you use very hot water it will kill the tiny plants.

If you allow your mixture of all the ingredients except the flour to sit for 10 minutes, you will see how fast the yeast begins to work. Your mixture will be producing a bubbly foam on the top in just this short amount of time. This foam is a result of the *fermentation* that is taking place inside the mixture. Fermentation is a chemical process that produces a gas.

Just as the plants around you take in one substance (carbon dioxide) and give off another (oxygen), the yeast plants take in the honey (or other sweeteners) and give off alcohol and carbon dioxide. The carbon dioxide (a gas) becomes trapped in the dough and causes the bread to rise.

The kneading you did in preparing the dough is very important in helping the bread to rise. The kneading helps to produce the *glutens,* which form the structure of the bread and make it elastic or stretchable.

When you place the loaves in the hot oven, the bread rises even farther because yeast works faster the warmer it gets. However, the dough soon reaches a temperature that is high enough to kill the yeast and cause the alcohol to evaporate. The loaves stop rising and remain in the oven until they have changed from wet dough to dry, tasty bread.

MAKING BAKING POWDER BISCUITS

If you look at the list of ingredients for this recipe, you will notice that they are very similar to those which you used to make yeast bread. There is one major difference, however. There is no yeast used in this recipe. Baking powder causes the dough to rise in this recipe, and you will see that it works much faster than yeast.

The ingredient you use to make the bread rise (called a *leavening agent*) depends on the type of bread you are making and the amount of time you have in which to work. Yeast makes a very smooth, yet sometimes heavy, loaf of bread that takes a long time to make. Baking powder makes a very coarse, light type of bread and is very fast acting.

You may love the smell of fresh-baked breads, but may be too hungry to wait very long. This is when you should make biscuits. In a very short time they will be out of the oven ready and waiting for you to spread on jelly and homemade butter.

Materials

2 cups flour (500 ml, 325 g)
3 teaspoons baking powder (15 ml)
1 teaspoon salt (5 ml)
¼ cup margarine (60 ml, 60 g)
1 to 1¼ cup milk (250 to 310 ml)

Method

1. Turn oven to 450° F (230° C) and grease a baking sheet.
2. Mix dry ingredients in a bowl.
3. Add margarine. Work it in with a pastry blender *or* fork until the margarine is in very small pieces and well covered with flour.
4. Add 1 cup (250 ml) of milk and stir with a fork. If the mixture seems very dry, add the remaining ¼ cup (60 ml) milk.
5. Drop from fork onto greased baking sheet. Each biscuit should be a piece of dough about 3″ (7.5 cm) wide. You should have about one dozen biscuits.
6. Bake 12 to 15 minutes or until golden brown.
7. Serve while still hot with homemade butter.

What Is Happening Scientifically

Baking powder is a mixture of baking soda (sodium bicarbonate), an acid substance, and a filling of cornstarch *or* flour. When the dry ingredients are mixed together you will notice that nothing unusual happens. But when you mix in the milk, you will see the mixture start to thicken. This is because the baking powder has begun to work.

Our modern baking powder is double acting. That means the baking powder works twice, once in the bowl and again in the oven. This is handy because the mixture will not be harmed if there is a delay in putting the dough in the oven.

The first reaction takes place when the milk and sodium bicarbonate mixed together produce carbon dioxide. The carbon dioxide is trapped in the wet dough and causes the dough to rise.

The second reaction takes place when the heat of the oven reacts with the wet acid and releases more gas to cause the dough to rise even farther. Once the reaction has taken place, the dough will no longer rise.

The heat of the oven then continues baking the ingredients until you take light, fluffy biscuits out of the oven.

UNLEAVENED BREAD

You may be wondering why anyone would want to make bread without using a leavening agent such as yeast or baking powder. Years ago, there were two major reasons. Yeast needs to be kept very cool, and people who lived in hot areas found they could not keep the yeast alive for very long. Also when preparing for long journeys, people could not always know exactly how much yeast to bring along, and they occasionally ran out.

American pioneers in their covered wagons took baking powder with them when they traveled west, but when the baking powder became wet or was used up, they still needed to eat something that was similar to bread. So they mixed different kinds of flours together and added salt for taste. Water was used as the liquid ingredient because that was usually the most available liquid. This dough was then cooked on a griddle and ended up looking much like a cracker.

The unleavened bread, matzoh, is traditionally eaten during the Jewish celebration of Passover. In fact, this religious holiday is occasionally called the Feast of Unleavened Bread. The tradition began 3,000 years ago when the Hebrews were forced to flee from Egypt. In preparing for their journey, they did not have enough time to wait for yeast bread to rise. So they quickly baked unleavened bread to take with them.

By following this recipe, you can make a bread much like that made by the early pioneers. At the same time, you can compare the taste and texture of unleavened bread with the two types of leavened bread you made previously.

Materials

2 cups whole wheat flour (500 ml, 260 g)
½ teaspoon salt (2.5 ml)
½ to ¾ cup warm water (125 to 185 ml)

Method

1. Blend flour and salt in mixing bowl.
2. Add water until dough is evenly wet and will stick together.
3. Knead on floured surface according to directions on p. 16. At first the dough will be crumbly, but after about 5 minutes, it will become smooth.
4. Divide dough in half and roll out on floured surface. Dough should be about ⅛″ (.25 cm) thick and slightly smaller than the griddle on which it will be cooked.

5. Lightly flour the griddle and place over low heat.
6. Place the dough on the griddle and cook 15 to 18 minutes on each side. Dough is done when the outside is crisp but the inside is still slightly soft.

What Is Happening Scientifically

Both the yeast bread and the baking powder biscuits had two things in common: their ingredients were very similar and they each used a leavening agent. This recipe contains similar ingredients, but the leavening agent is left out. Therefore, there is no way to make the mixture rise. Flour, salt, and water have no chemical ingredients that will react with each other to produce a gas.

The kneading of the dough does help the mixture become much smoother than if it were mixed with a spoon. Compare the other leavened breads with this bread and notice the difference in texture. The others were light and airy and easy to chew. The unleavened bread is much heavier and much chewier.

MAKING RAISINS AND OTHER DRIED FRUIT

Have you ever heard the sayings "As wrinkled as a prune" or "As dried up as a raisin"? Both prunes and raisins are familiar fruits in disguise. Prunes are plums, and raisins are grapes that have been dried as a means of preservation. Their names and appearance have been changed. Now they don't look at all like the original fruit.

Drying fruits and vegetables as a means of preservation has been a custom for thousands of years. Long before the invention of our modern canning process, people were drying their fruits and vegetables to save them for use during the long winter season or to carry with them on long trips.

This means of preservation was probably first discovered by accident. Fruits and vegetables left on the trees and vines during warm weather would dry in the sunshine. But people soon discovered that in drying their fruit in this manner, they lost much of it to animals and changes in the weather. So they began picking the fruit when it was ripe and drying it outside on hot, sunny days under controlled conditions.

Materials

Fruit—fresh, ripe, without any bruises
2 drying trays—old window screens that have been scrubbed clean *or* two frames that have been covered with cheesecloth
Blocks of wood *or* rocks

Method—Drying Outdoors

1. Select firm, ripe fruit.
2. Wash in cold water and drain.
3. Spread fruit on one of the drying trays in a single layer. Cover the tray with the other tray, being careful not to press down on the fruit. Use blocks of wood *or* clean stones to hold up the top tray.
4. Using wooden blocks *or* stones to keep the tray off the ground, place the tray in a sunny spot.

5. About 5 *or* 6 times during the day, turn the food so it will dry on all sides.
6. Take the food inside before the dew sets in in the evening. Put it out again the next day after the dew is off the ground. Be sure the days you choose are very hot and sunny.
7. The fruit will be dry in 4 *or* 5 days, depending on the dryness of the air and the temperature. Your fruit is finished when it feels dry and leathery on the outside. Do not wait until the fruit feels brittle. Squeeze a piece of the fruit. If moisture comes out on your fingers, the fruit is not finished.
8. Store the dried fruit in a plastic bag for four days. If your fruit still looks moist, place it back in the sunshine for another day.
9. When completely dry, store the fruit in a tightly covered container, and store in a cool, dry place.
10. Eat the fruit as it is for a snack, or add it to your morning cereal or yogurt.

Method—Drying in an Oven

1. Follow the directions below for preparing the fruit.
2. Turn oven to 150° F (65° C).
3. Place the trays and fruit in the oven.
4. Your fruit will take 6 hours or longer to dry. Test at the end of 6 hours by removing a few pieces and squeezing them. Food feels more moist when it is hot, so remove the pieces from the tray and allow to cool before testing.
5. When the fruit is finished, follow the directions above for storing.

Preparation of Fruit

RAISINS

1. Use white seedless grapes. Remove any that are bruised or not ripe (these will be small and hard).
2. Wash grapes in cold water.
3. Remove stems and dip in boiling water so the skins break. You can do this by putting a handful in a strainer and dipping this into a pot of boiling water.
4. Drain the grapes until water and juice no longer run out of them.
5. Spread on the drying trays and follow the directions for the method of drying you have chosen.

BERRIES

1. Wash berries.
2. Leave small berries whole, and cut larger ones such as strawberries in half.
3. Place on drying trays and follow the directions above.

CHERRIES

1. Wash cherries.
2. Remove the pits (stones) and the stems. Let the cherries drain until the juice no longer runs from them.
3. Place on trays and follow the directions above.

APPLES, APRICOTS, AND PEACHES

1. Remove the skin and the pits (stones) and cut the fruit into thin slices.
2. Place on trays and follow the directions above.

What Is Happening Scientifically

We have seen that yeast, which is a collection of one-celled plants, can be put to good use in our foods. But there are other multi-cellular plants, also fungi, that grow on foods and can make the food inedible. These tiny plants feed on the sugars and starches in the food. They start as *spores,* tiny seedlike cells that drop onto the food from the air and begin to digest the food and grow. The little spots of fuzz that you find on food that has been in the refrigerator for a long period of time are really spots of these plants.

Like yeast, these organisms need moisture to grow. They can be killed by high-heat cooking. But as the food cools spores fall on it from the air and the plant has a chance to start growing again.

Freezing also stops the growth of these tiny organisms, but this method wasn't available to people many years ago. Centuries ago, people discovered that by drying their fruits and vegetables they stopped the spoilage. By removing the water, they prevented the fungi from growing.

When you place the fruit in the sunshine you are drying it in the same way as the Indians and early settlers. You remove nothing from the fruit except the water, but your fruit will be preserved for many months. It will still contain the fiber and many of the vitamins and minerals that make fruit an important part of your diet.

MAKING YOUR OWN YOGURT

The people of many countries, especially Russia, Bulgaria, Yugoslavia, Syria, Lebanon, and India, have used yogurt as a part of their daily diet for thousands of years. But it has just recently become popular in Western countries. While everyone knows that yogurt is nutritious, some people even believe it helps them to live longer.

You may have to learn to like the tart taste of yogurt, but once you do there are many ways to serve it. Yogurt can be eaten plain or with fresh or dried fruit added. And it can be used in recipes in place of sour cream and can be frozen to make a dessert similar to ice cream.

The process of changing the liquid milk to a thick texture takes several hours, but is an interesting one to set into action.

Materials

1 quart milk (regular *homogenized milk* or non-fat dry milk that has water added to it) (1 liter)

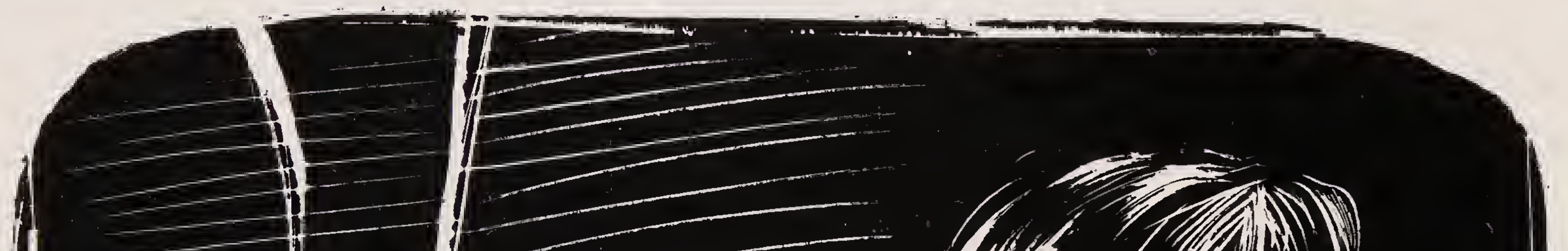
¼ cup powdered non-fat dry milk (60 ml)

3 tablespoons plain yogurt (45 ml); this is your "starter," and must have live yogurt culture in it. Be careful not to use pasteurized yogurt.

Method

---

1. Combine the milk with the non-fat powdered milk in a heavy saucepan and mix thoroughly.
2. Heat the mixture until it registers 180° F (82° C) on a cooking thermometer.
3. Remove from heat and let the mixture cool to 113° F (45° C).
4. Mix a little of the warm milk with the yogurt "starter" in a small bowl until it is smooth and thin.
5. Add this mixture to the rest of the warm milk. Mix well.



6. Pour the mixture into a large glass jar that has been warmed slightly. It is important that your jar is very clean. If it isn't, the wrong type of bacteria will grow in your yogurt and give it a strange taste. It is helpful if the jar has a wide mouth.
7. Cover the jar with cheesecloth *or* plastic wrap. Place the jar in a pan of hot water deep enough that the water comes up to the neck of the jar. The water in the pan should be 109° F (42° C) and should be kept close to this temperature during the making of the yogurt.
8. Place the pan on a burner that won't be needed for several hours. Use a low heat every once in a while to keep the temperature constant. It is important that the jar not be moved at all during the process. If the mixture is moved, the thickened milk will clump together and your yogurt will be lumpy instead of smooth.
9. It will take about 4 hours or more for the yogurt to thicken properly.
10. Remove the jar of yogurt from the pan and store in the refrigerator. Your yogurt will stay fresh for about 2 weeks. Fruit can be added for a special treat when you eat the yogurt.

What Is Happening Scientifically

Yogurt is made from milk to which friendly *bacteria* called acidophilus have been added. These bacteria were given this name because it means "acid-loving." When they are added to milk they immediately begin to feed on the milk sugar, *lactose,* and change it into lactic acid. This feeding, called fermentation, causes a chemical change in the milk. The lactic acid produced by the fermentation gives yogurt its tart taste.

The lactic acid causes the protein to curdle and make the milk thick. This change in the protein makes it easier to digest.

Just as you had to be careful and not put yeast in water that was too hot for it, you must also be careful when putting the yogurt culture (the live bacteria) into the milk. Liquid that is too hot will kill both the yeast and bacteria because they are living organisms. And just as you work better when you are not cold and shivering, the bacteria work better if you keep the temperature of the mixture slightly warm.

There are several reasons for the popularity of yogurt. The first is that it is full of vitamins and protein. It is also believed that yogurt aids the digestion and helps keep blood vessels from clogging up.

The second reason is the availability of the ingredients. It can be made from many different kinds of milk—pasteurized, raw, or non-fat—and can come from a cow, goat, buffalo, ewe, or reindeer.

The third reason is preservation. In warm climates, making yogurt is a means for preserving milk that would otherwise spoil quickly in high temperatures. Bacteria that cause this spoilage need food. By changing the bacteria's food, milk sugar, into lactic acid, the bacteria cannot live because they have no food supply.

MAKING BUTTER

The butter you see in the stores today is shaped in sticks or blocks and neatly wrapped in paper. Of course, butter that is made at home is not quite so evenly shaped, but it is made from the same ingredients and tastes much the same. You may even think that it tastes better, and it probably does. It will be much fresher than the butter that has stayed on the shelf in the store for a long period of time.

A picture of someone sitting by a large wooden barrel holding a stick that looks like a broom handle probably comes to your mind when you think of making butter. Years ago, this was the way farmers made butter for their families. The large container was necessary because these people would be making a large amount of butter each time. You need only a large jar because you are making a much smaller amount of butter.

The stick, which was called a clapper, had wooden pieces on the bottom much like a propeller. The clapper was used to move the milk around and cause the butter to take shape. A marble in your jar will act as a small clapper, and by shaking the jar you will get the same result.

Materials

1 pint heavy whipping cream (473 ml)
Large jar with tight fitting cover
1 clean marble
¼ teaspoon salt (1.2 ml)

Method

1. Wash marble thoroughly.
2. Place the cream and the marble in the jar and put the cover on tightly.
3. Shake the jar steadily in an up-and-down motion. Soon the cream will begin to thicken and you will not be able to hear the marble.

4. After the cream thickens, you will begin to hear the marble again as the pieces of fat begin to stick together to form butter.
5. When you can see several pieces of butter floating in the liquid, remove the butter pieces from the jar.
6. Pat the pieces together to force the remaining liquid out, and rinse under cold water.
7. Remove a small piece of butter and set aside.
8. Sprinkle salt on the remaining butter and work it in by pushing the butter with the back of a spoon and then folding the butter over and pushing it again. Do this several times so the salt will be mixed in thoroughly.
9. Store in the refrigerator until ready to use.
10. Compare the taste of the salted butter with the unsalted butter you set aside.
11. Taste the liquid that remains after the butter is removed from the jar. This is called buttermilk and is very rich tasting because there are still fat globules remaining in it.

What Is Happening Scientifically

Milk is filled with many tiny, round pieces of fat called fat *globules.* Just as when making mayonnaise the salad oil (a type of fat) would not stay mixed with the vinegar, the fat in the milk will not stay mixed with the water, which is the main liquid in milk. If you let a bottle of non-homogenized milk sit on a table for a while you will notice the cream, or fat, rising to the top. The cream is thicker and lighter than the milk because of all the fat globules that it contains.

When you put the cream into a jar and shake it, you are giving the fat globules a chance to come into contact with each other and stick together. Because you are shaking the jar, the globules will bump into each other with enough force to make them stick together. If you were stirring the cream with a spoon there would not be enough force to cause the fat to stay together. The marble or clapper in the bottle is also helping to push the pieces of fat together.

Salt is added for two reasons. Salt is a preservative and when it is added to butter, it helps keep the butter fresh. Salt also enhances the taste. When added to butter, salt gives it a much stronger taste. Compare the taste of the salted butter with the butter you set aside. Which do you prefer?

The same thing that is happening in your jar also happens in the butter churns that farmers use and in the giant machines used today. No matter which method is used, the results are the same —creamy golden butter.

Butter is a source of fats, which are needed for heat and energy. It also contains a supply of vitamin A, which is necessary for growth, and vitamin D, which prevents a disease called rickets.

HOMEMADE ICE CREAM

Everyone knows that licking a dripping ice-cream cone is an enjoyable way to spend a hot summer afternoon. And an ice-cream sundae makes a special occasion a little more special. But did you know that you can make your own ice cream right in the freezer compartment of your refrigerator?

You don't need a big factory or an expensive freezer to make ice cream; all you need are a few kitchen utensils and a refrigerator with a freezing compartment. The ingredients used in any ice cream are basically the same, but the different methods used in making it will produce a slightly different texture each time.

By following this recipe, you will have ice cream that is coarser than the kind you buy in the store, but it will still be delicious. And, you can say you made it yourself!

Materials

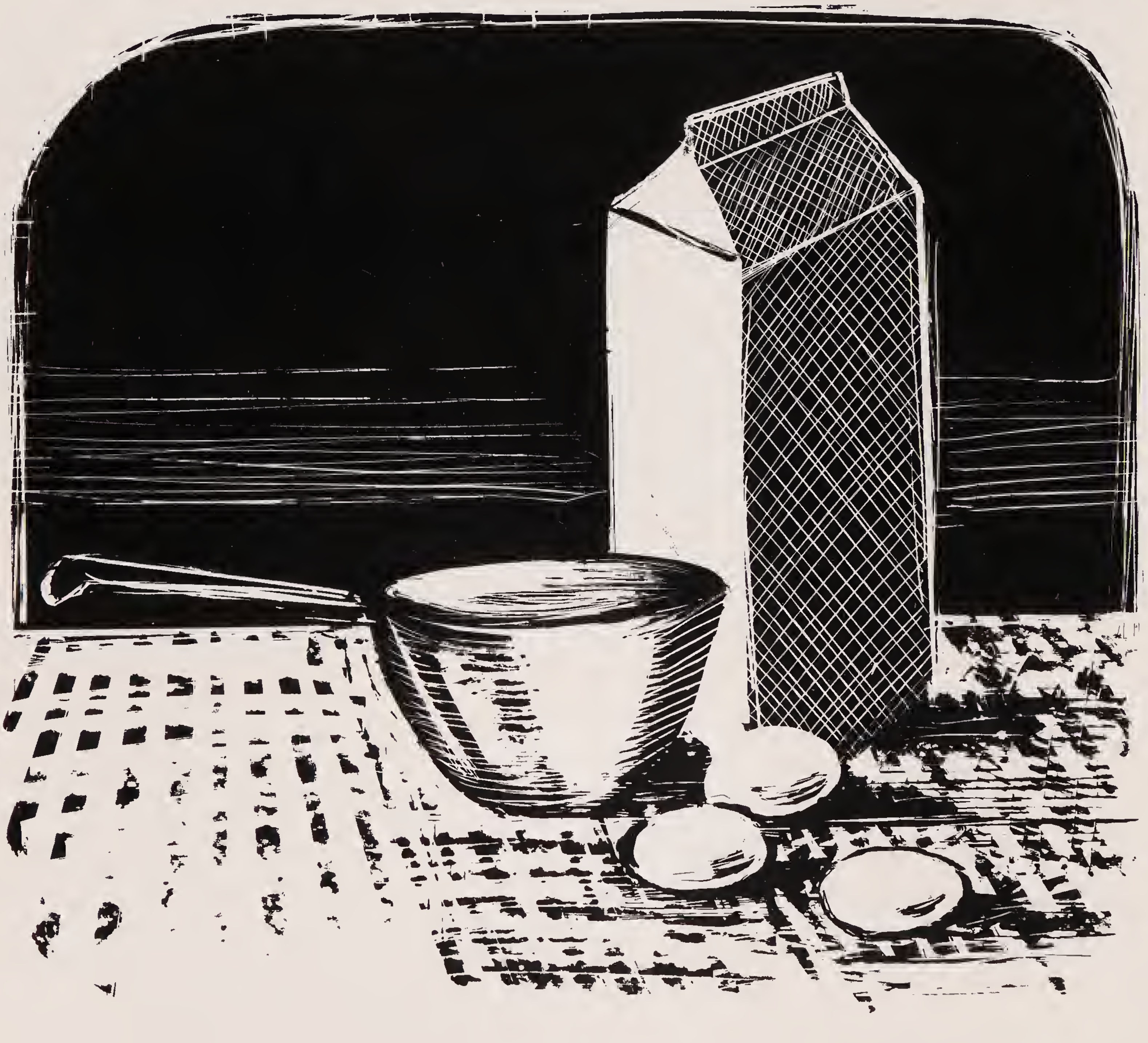
½ cup sugar (125 ml, 105 g)
¼ teaspoon salt (1.2 ml)
1 cup milk (250 ml)

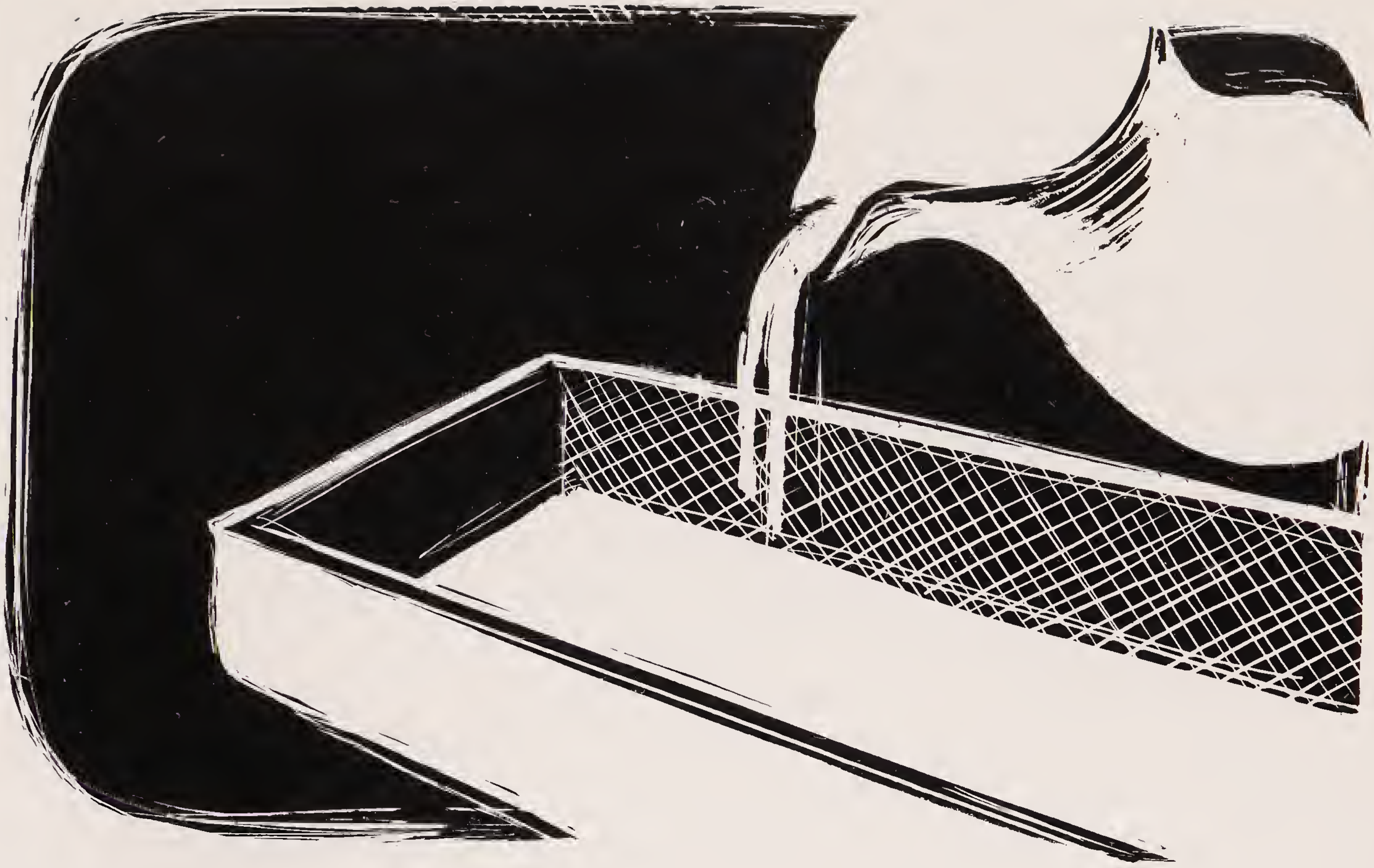
3 egg yolks, beaten
1 tablespoon vanilla (15 ml)
1 cup whipping cream (250 ml)
Electric mixer

Method

---

1. Blend sugar, salt, milk, and egg yolks in a saucepan.
2. Cook over medium heat, stirring constantly, until mixture just begins to boil.
3. Remove from heat and cool for 30 minutes.
4. Add vanilla and stir well.
5. Pour mixture into ice tray, with separations removed. Place in the freezer compartment of the refrigerator for about an hour, or until the mixture becomes mushy and partly frozen.





6. In small bowl, whip cream until stiff.
7. Empty partly frozen mixture into a large chilled bowl and beat with a mixer until smooth.
8. Slowly stir whipped cream into the beaten mixture.
9. Pour into two refrigerator trays and return to freezer.
10. During the first hour of freezing, stir the mixture frequently (at least 6 times).
11. Freeze for 3 to 4 hours.

What Is Happening Scientifically

Have you ever watched a puddle freeze? If you have, you have probably noticed several different stages that the liquid goes through before it is completely frozen. First the liquid becomes very cold. After it reaches the freezing point, it becomes mushy and then begins to form into a solid piece of ice. The outside becomes hard first and then the middle gradually becomes frozen. If you stir the liquid at any time during the freezing, you will change the shape of the final piece of ice.

When making ice cream you are interrupting the normal freezing process. If you put the entire mixture into the freezer and left it there, it would freeze into a solid block. However, because you are stirring it during the first hour of freezing, you are breaking up the ice pieces into small individual particles. These particles will continue freezing individually, not as a solid block. The more you stir the mixture during that first hour, the smoother your ice cream will be because you are breaking the ice into smaller and smaller pieces.

Your ice cream will not be quite as smooth as that made in a factory. There, ice cream is stirred continuously until it is completely frozen. You are stirring yours for only a short period of time and you are not stirring continuously. But it's still ice cream. And it's still *good*.

GLOSSARY

Bacteria—one-celled plants that can be seen only under a microscope.

Centrifugal force—the force that causes an object to move outward when it is spun in a circle.

Dormant—resting; sleeping; inactive.

Embryo—a young organism in the early stages of development; a beginning or underdeveloped stage.

Emulsifier—the ingredient that keeps liquid suspended in another liquid in what would ordinarily be a temporary suspension.

Emulsion—a liquid suspended in a liquid.

Fermentation—the action of an organic substance (such as yeast or bacteria) which produces a chemical change. Bubbles or foam are often a sign of this type of activity.

Fungus—a spongy growth of very small plants such as molds and mildews. The plural of fungus is fungi.

Germinate—to begin to grow or develop; to sprout.

Globule—any small, round particle.

Gluten—a substance in wheat flour that gives dough its stretchability.

Homogenized milk—milk that has been processed so that the particles of fat have been broken down into tiny pieces so they become permanently mixed in the liquid.

Ingredient—a single part of a mixture.

Knead—to work or press dough with the hands.

Lactose—a sugar present in milk.

Leavening agent—the ingredient that causes dough to rise and become light and airy.

Nutritious—containing vitamins, minerals, or proteins that are used in body building and repairing; healthy.

Organism—a plant or animal able to carry on life.

Particle—a very small part of a substance.

Preservatives—chemicals added to food to keep it from spoiling.

Protein—a complex chemical compound made up of amino acids, that is a necessary part of the cells of plants and animals.

Refine—to take out unwanted substances; to purify.

Spore—a seedlike reproductive body.

Texture—the way something feels, that is, smooth, silky or coarse.

Utensil—a useful tool or instrument, especially one used in a kitchen.

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